Project supervision - an engineering approach

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Project Supervision

An Engineering Approach

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Introduction

This report introduces a group based supervision method for engineering students that has been practised (with variation) for more than fifteen years at the image analysis group at DTU informatics.

It is based on the belief that engineering students should be prepared for their new role as development engineers or PhD students as part of their master thesis writing. The major principles are:

Ownership The student should feel that their project is their own. Ideally, they should formulate the project themselves.

Write early We strongly encourage the students to write and generate figures and images already from the first week of the project period.

Management The student is considered project manager of his own project. The supervisor is a guide or coach.

Plans The student is asked to write a project plan as the first thing of the project.

Group Meetings A group of students and supervisors meet every week on a fixed weekday.

It is the assumption that one supervisor supervises three to five projects simultaneously. The core of the supervision is the weekly meetings where the students present what they have been doing and what they plan to do. By default, all students are present to all meetings. Weekly meetings are scheduled to be at a specific day at a specific place for the entire process.

Project Start

At the project start a kick-off meeting is held where the students are explained what are expected from them. In addition, it is also described what they can expect from the supervisors. In short, they can expect one weekly meeting with their supervisor, where the supervisor will have read their weekly report.

During the start-up meeting, the following topics are covered:

Thesis This is the product of all this. How does it look? How long is it? How is structured? A typical thesis is shown and discussed.

How to read paper Do NOT read the entire paper the first time. Read abstract, read introduction; look at the images/figure, read the conclusion. Is it worth it? If yes, read the entire paper. When the paper is read, use five minutes to enter it into your Bibtex/Endnote/Refman database and write a short description (see example weekly report for how this is done).

CampusNet A CampusNet[1] group is created with the students and the supervisor as members. This group should be used for messages and questions related to basic problems. Typically, it is used for information about time and place of the weekly meeting and for student evaluations.

Project plan and report templates Templates for project plans and weekly reports exist and they are described.

Project description The students are asked to give a 30 seconds presentation of their understanding of their own project. This is used as a basis for formulating a precise project description (or thesis introduction).

It is assumed that the student has some technical background and that the supervisor's role is on the scientific/academic topics. We therefore strongly encourage the students to use each other concerning "tool-questions", like the use of Matlab, Latex, C++, Visual Studio, Word, Bibtex, Refman, and Endnote. "Tool-questions" should be posed in the CampusNet group. The student cannot expect a "tool-answer" from the supervisor if it has not been posted in the CampusNet group before.

Project Plan

During the first weekly meeting, the students are asked to produce a plan for their project. An example plan is given. The plan is used during the weekly meetings and is consistently updated. The most important is not that the deadlines in the plan are kept, but that a plan exists and that it is used actively. This will introduce the students to what they will (with a high probability) experience in their job just after their thesis.

The students are also asked to judge the "risk" of each of their tasks. Risk in this context is the risk of not being finished on time. While a literature study

[1] CampusNet is the DTU Intranet

has a very low risk, data gathering can for example have a higher risk. An example project plan with a risk analysis can be seen in Appendix A.

Some students will probably think that they are going to do research and therefore there is no need to learn to do project plans. We quickly try to get them out of that delusion. Research funding relies heavily on the formulation of realistic research plans. A good PhD application includes a well described research plan for example.

Most projects are done in collaboration with external partners, for example companies and hospitals. The project plan serves as an initial contract between the student, the supervisors, and the company. We also see it as a protection for the student that there already from the start is an agreement of the scope of the project.

Furthermore, the students should describe their own understanding of their project. This should be formulated, so it can directly be used as an introduction to their thesis. This description should be delivered latest two weeks after project start and also serves as a contract between the student, the supervisors, and external partners. It should include the background of the project, the motivation, description of potential system setup, data description, and potential methods to be evaluated

Weekly Report

The students are asked to write a weekly report that should be delivered so the supervisor has it before the weekly meeting (or uploaded on CampusNet). The weekly meeting is based on this report. The weekly report serves several purposes. It should be formulated so it can be directly used in the final thesis. It should make the student stable users of their text processing system (LaTeX, word) and reference handling system (Bibtex, Endnote, Refman). Furthermore, students are strongly motivated to create and use figures, tables, and drawings in their reports. Experience shows that some students try to gather all references and create all images during the last weeks of their thesis writing. This is time consuming and extremely frustrating. The weekly report should help that. A LaTeX template (including bibtex) exists and is described for the students. An example weekly report can be found in Appendix B.

Weekly Meeting

The weekly report is used as the basis for the weekly meeting. Each student is asked (kindly and friendly) to describe what he or she has been doing the last week. The supervisor should act like a coach and ask constructive questions. Often the student is asked to draw schematically on the blackboard. After that, it is discussed what should be done the next two or three weeks. We try to motivate the students to present their ideas and the supervisor should act more like guide. When a strategy or plan has been decided, it is very important that the student write this down as a bullet list. This will go directly into the next

weekly report in the section "plan for the next weeks". Furthermore, the project plan should be updated accordingly. All students are present during the weekly meeting. Generally, we try to avoid a one-on-one conversation and encourages the other students to comment and come with ideas.

Thesis

Two-thirds into the project period a weekly meeting is focused on practical thesis writing. The general structure and potential templates are presented. For most students that have handed in weekly reports it is normally quite easy to write the final thesis. It is mostly a question of gathering the weekly report and polishing the report to get an overall flow of the text.

We strongly encourage the students to deliver a part of their thesis as an article that can be submitted to a conference or a journal. In some cases we discus a publication strategy during the supervision.

Student Presentation

For each group of students we try to arrange a poster session where the students should present their work as on a conference. Normally, this is done at the yearly conference called "DTU Visiondays" that are organised by the image analysis and computer graphics group at DTU. The students generally produce high quality posters and are eager to present the results to the conference participants.

Student Evaluation

In spring 2009, a supervision group consisting of the following students:

- 1 project with 2 bachelor students in medical image analysis
- 1 project with 1 bachelor student in geostatistics
- 1 project with 1 master student in geostatistics
- 1 project with 1 master student in image analysis
- 1 project with 1 research assistant in image analysis

We were four supervisors:

- 1 assistant professor in medical image analysis (me)
- 1 associate professor in geostatistics
- 2 professors in image analysis

It should be said, that geostatistics is comparable to image analysis and that there is a large overlap in the used methods.

As can be seen we mixed both bachelor projects and master projects and we even included one research assistant that is currently continuing his master project work.

Two thirds into the supervision process a student evaluation questionnaire was answered by the students. It can be seen in Appendix C. The goal of the questionnaire is to optimise our supervision from the students' viewpoint.

The answers to question 12 give the overall impression that the students are happy with the supervision. This is also the general conclusion from the evaluation of the other answers. It seems that the students generally like group supervision and to be the project managers of their own project.

We have also succeeded in mixing several levels of students. Furthermore, it is also nice to see that the students can handle the supervision give by several different supervisors. However, we are also very aware that the main supervisor is the one that have the overall responsibility for his student.

Our experience this year was that most of the students delivered weekly report from 5 to 15 pages.

Future Improvements

Based on the students evaluation there are a few things that need to be considered. The first is the number of projects that can be supervised simultaneous. It seems that four is a good number. Secondly, we need to consider to what degree we want to mix different levels and background of students.

A larger issue is the question of learning objectives. We have cases, where external censors have asked for the learning objectives for the project, to be able to give a fair evaluation. We think this is a valid point and consider trying to formulate learning objectives from the start of each project.

Conclusion

A framework for student supervision has been presented. We as teachers are very happy with this approach. It is effective in the sense that we spend two to three hours every week of supervision and we do not have students continuously dropping in. The evaluation from the students largely agrees on this positive experience.

Obviously, the presented supervision method is mostly focused on "process" supervision, meaning learning to write and present. The hardcore academic supervision should of course also be considered. For us it still works fine. The main supervisor for the students can still give the academic supervision within this framework.

Appendix

A Example Master Thesis Project Plan

This is an example project plan for a master thesis. It is an initial plan and will be revised during the project.

Week	Activity	Risk
1	Write a project plan	1
2+3	Literature study	1
4–6	Data gathering at the company	4
7	Initial data analysis	2
8-12	Implementation and testing of rigid registration	3
?	Implementation and testing of non-rigid registration	3

Risk Analysis

In the plan the risk is classified using a scale from 1 (no risk) to 5 (high risk). The risk is described as the chance of the activity being delayed.

The first high risk item is the data gathering. The expert at the company has promised to help, but he is very busy. However, he has promised to be finished within four weeks and hopefully two.

The implementation of the rigid and non-rigid registrations should theoretically be straightforward. However, it is difficult to judge how long it will take and some practical issues will for sure also pop up.

B Example weekly report

This is an example weekly report. It is delivered as the first weekly report in a master thesis project named "Analysis of Shapes of Ear Canals".

Literature

Hint:*Try to write this section so it can be used directly in your Previous Work chapter in your thesis.*

Surface reconstruction from unorganised points has been an active research area for the last decade. One technique is developed by Hugues Hoppe in 1994 [2]. It is based on a signed 3D-distance transformation of the point cloud. The result of the distance transformation is a voxel volume where the value of each voxel is the distance to the nearest point. The surface can then be reconstructed by extracting the zero-value contour of the voxel set. A standard method to perform this contouring is the marching cubes algorithm [3].

Several methods of reconstructing surfaces are based on the 3D Delaunay triangulation of the input points. A recent method called the Power Crust is using the medial axis approximation given by a pruned Voronoi diagram called the power diagram [1].

What has been done this week

Hint:*Try to write this section so it can be used directly in your thesis. Also use drawings and figures.*

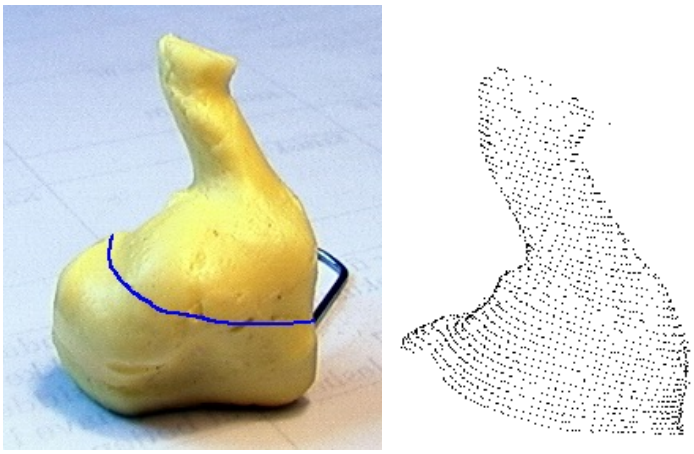
The data consists of laserscans of 30 ear impressions. The ear impressions are scanned using a `3Shape S-200` laser scanner. An ear impression and the corresponding laser scan can be seen in figure 1.

Project status according to the study plan

According to the plan, the scanning of the ear impressions should have been completed last week. However, it took longer than expected and therefore the project is delayed one week.

Plan for the next weeks

1. Scanning of ear impressions
2. Surface reconstruction
3. Initial 3D alignment



(a) Ear Impression (b) Point Cloud

Figure 1: An ear impression and the corresponding point cloud. For clarity only the points on the visible surfaces are shown. The blue line on the ear impression corresponds to the lowest samples of the point cloud.

References

[1] N. Amenta, S. Choi, and R. Kolluri. The power crust. In *Proc. ACM Symposium on Solid Modeling*, pages 249–260, 2001.

[2] H. Hoppe. *Surface reconstruction from unorganized points*. PhD thesis, University of Washington, Department of Computer Science and Engineering, June 1994.

[3] W. E. Lorensen and H. E. Cline. Marching cubes: A high resolution 3D surface construction algorithm. *Computer Graphics (SIGGRAPH '87 Proceedings)*, 21(4):163–169, July 1987.

C Student Evaluation

Student evaluation of supervision.
Spring 2009

6 har besvaret dette evalueringsskema

1. Jeg synes, at 1.5 time per uge er

Alt for lidt	0	0.00%
For lidt	1	16.67 %
Passende	5	83.33 %
For meget	0	0.00 %
Alt for meget	0	0.00 %

2. Jeg kan godt lide at præsentere mit arbejde for gruppen:

Helt uenig	0	0.00 %
Uenig	0	0.00 %
Hverken eller	2	33.33 %
Enig	4	66.67 %
Helt enig	0	0.00 %

3. Jeg synes, at det er forvirrende at der er flere, der vejleder mig:

Helt uenig	1	16.67 %
Uenig	5	83.33 %
Hverken eller	0	0 %
Enig	0	0 %
Helt enig	0	0.00 %

4. Jeg synes, at det er godt at blive vejledt, som om jeg var min egen projektleder:

Helt uenig	0	0 %
Uenig	0	0 %
Hverken eller	0	0 %
Enig	5	83.33 %
Helt enig	1	16.67 %

5. Jeg føler, at jeg har et ejerskab over mit projekt:

Helt uenig	0	0 %
Uenig	0	0 %
Hverken eller	1	16.67 %
Enig	2	33.33 %
Helt enig	3	50.00 %

6. Jeg ville foretrække kun at mødes med min projektvejleder:

Helt uenig	1	16.67 %
Uenig	2	33.33 %
Hverken eller	3	50 %
Enig	0	0 %
Helt enig	0	0.00 %

7. Jeg synes, at det er godt at skrive ugerapporter:

Helt uenig	0	0.00 %
Uenig	0	0.00 %
Hverken eller	0	0.00 %
Enig	2	33.33 %
Helt enig	4	66.67 %

8. Jeg synes, at jeg får god feedback på mine ugerapporter:

Helt uenig	0	0 %
Uenig	0	0 %
Hverken eller	0	0 %
Enig	5	83.33 %
Helt enig	1	16.67 %

9. Jeg synes, det bedste antal studerende i en vejlednings-gruppe er:

3	1	16.67 %
4	4	66.67 %
5	0	0 %
6	1	16.67 %
7	0	0 %

10. Jeg synes, at der er godt at blande bachelor- og eksamensprojektstuderende:

Helt uenig	0	0 %
Uenig	1	16.67 %
Hverken eller	1	16.67 %
Enig	2	33.33 %
Helt enig	2	33.33 %

11. Jeg synes, at Rasmus Paulsen giver god vejledning:

Helt uenig	0	0 %
Uenig	0	0 %
Hverken eller	0	0 %
Enig	1	16.67 %
Helt enig	5	83.33 %

12. Generelt synes jeg, at vejledningen fungerer:

Meget dårligt	0	0 %
Dårligt	0	0 %
Tilfredsstillende	1	16.67 %
Godt	3	50 %
Meget godt	2	33.33 %

13. Hvad går godt? - Og hvad er grunden til det?

- 1)Ugerapporter giver et godt grundlag for den studerende til at blive "holdt i gang" med projektet. 2)Alle har interesse i hinandens projekter
- Jeg syntes det er rigtig godt at få input fra flere vejleder. Hvis vejlederen er i tvivle om noget kan han/hun rådføre sig med de andre.
- Møderne er det en god måde at få opfrisket hvad status er og hvad der skal laves til næste gang. "Ved du hvad du skal lave i næste uge?" er altid et godt spørgsmål.
- Nu bliver det en bedømmelse, som er en blanding af, hvordan jeg selv har oplevet konceptet med ugentlig vejledning, og mit indtryk af dette forløbet, grundet min lidt svævende status som både modtager af vejledning og en slags vejleder.

  Jeg synes generelt, det er et kæmpe privilegie, at studerende har et ugentligt vejledningsmøde, og jeg synes, at det giver en god dynamik, at der er andre studerende til dette møde. Det gør, at man kan få bevilget mere tid, når der er brug for det, og måske bruge lidt mindre i skrivefasen, eller når det bare kører.

  Det er en god måde, at få en (konceptuel) forståelse andre problemstillinger gennem de andre studerendes præsentationer, og jeg synes egentlig ikke, det er specielt væsentligt, om de forskellige områder har fagligt overlap eller er helt forskellige.
- Mange input giver god inspiration, og samtidig lærer man at sortere og tage stilling til i hvilken retning man selv ønsker projektet skal udvikle sig. Samtidig får man noget træning i at præsentere hvad man sidder og arbejder med.

  Ugerapporter er et klart plus, da man fastholdes i skriveprocessen.

14 Hvad går mindre godt? - Og hvad er grunden til det?

- Det kan være forvirrende som studerende når for mange vejledere, vil komme med ideer til projektet. Herfra er det vigtigt for den faktiske projektvejleder, at gøre det klart for den studerende hvad der er relevant.
- Master projekterne kan være svære at forstå for bachlor studerne og tilsvarne kan bachlor projekterne være spild af tid for master studerne.
- Holde sig til planen. Grunden: arbejder formentlig ikke nok ;)

15 Hvilke ændringer vil jeg foreslå?

- En lidt mindre mødegruppe end den eksisterende
- Hold bachelor og master adskildt og brug mere tid på at lade de studerne fremlægge deres resultater/teori på tavlen.
- Jeg vil foreslå, at spørgsmål 9 bliver ændret til antal projekter i stedet for antal studerende. Jeg synes, 3-5 projekter er passende, i den lave ende hvis der er mange flerpersons projekter og i den høje ende for enpersons projekter. At man fra tid til anden får gennemført, at en studerende laver en gennemgang af kerneteori i eget projekt.